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Microresonator frequency combs for long-haul coherent communications

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***Abstract*—Microresonator frequency combs provide a promising platform as multi-wavelength light sources for WDM. The results discussed here show that microresonators can be used in long-haul optical communications systems.**

Keywords—Coherent communications; Integrated optics.

I. Introduction

Commercial wavelength-division multiplexed (WDM) communications systems typically employ several free-running lasers. Each laser provides a carrier wave that is modulated and used as a data channel. Demonstrations have shown that there are performance gains when the lasers are replaced by a frequency-stable multi-wavelength light source such as an optical frequency comb. It allows not only decreasing the number of necessary lasers, but its lines' relative stability can be exploited for performance gains through fiber-nonlinearity precompensation [1], guard band minimization [2] or signal-processing simplification [3]. Of particular interest are microresonator frequency combs using integrated technology [4,5]. Recent experiments have shown impressive aggregate data rates [6] proving the potential of the technology. Here we describe the experiment and the results of long-haul data transmission measurements [7] performed using two normal-dispersion microresonator combs.

II. Comb-based data transmission

The two combs shown in Fig. 1 insets, operating in the stable modulation instability regime [8], are used as light sources in a WDM transmission link. The carriers extracted from the comb are modulated with coherent modulation formats (polarization multiplexed (PM) quadrature-phase shift keying (QPSK) and 16-ary quadrature amplitude modulation (16QAM)). The fiber link, consisting of a recirculating loop, allows us to measure bit error ratios (BERs) at regular intervals. Figure 1 displays the BER as a function of link distance. The achieved distances show that microresonator-based combs are capable of providing light sources for coherent optical WDM systems also in the long-haul regime.

These results will be discussed together with our latest developments, including comb-based transmission using higher order modulation formats [9].

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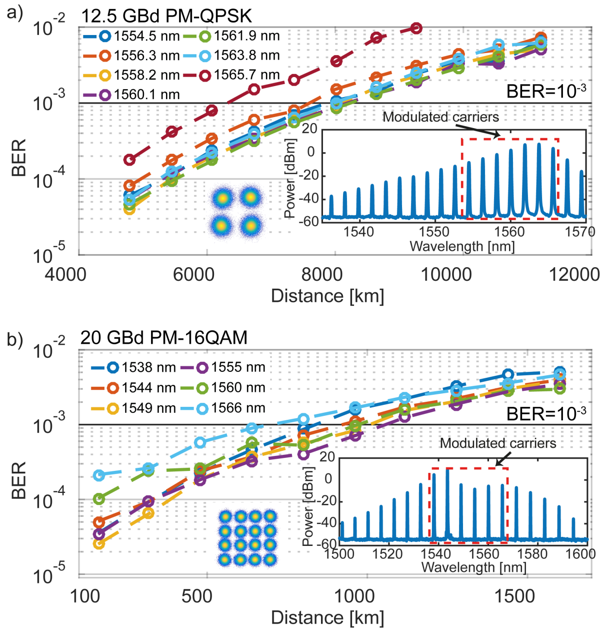

Fig. 1. Long-haul transmission results with the corresponding comb spectra in the insets. a) PM-QPSK transmission over >6300 km and b) PM-16QAM transmission over >700 km considering a BER-limit of 10^{-3}. Results from [7].

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